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(54) **SEPARATION MEMBRANE, METHOD FOR PREPARING THE SAME AND UNIT FOR PURIFICATION**

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(56) **References Cited**

U.S. PATENT DOCUMENTS

8,709,213 B2 * 4/2014 Compton B32B 9/04 162/348

2008/0149561 A1 6/2008 Chu et al. 210/500.38

(Continued)

FOREIGN PATENT DOCUMENTS

CN 101983758 A 3/2011
CN 102020271 A 4/2011

(Continued)

OTHER PUBLICATIONS

International Search Report and Written Opinion dated Jan. 24, 2014 issued in Application No. PCT/KR2013/008682.

(Continued)

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(57) **ABSTRACT**

A separation membrane for removing contaminants comprises: a hydrophobic membrane; and a graphene oxide layer formed to cover the hydrophobic membrane partially or wholly, wherein one surface of the hydrophobic membrane facing the graphene oxide layer has been hydrophilic-processed. The separation membrane is capable of enhancing removal efficiency on volatile contaminants, while maintaining a performance of the conventional separation membrane. The separation membrane is useful as a separation membrane for water treatment. Further, the separation membrane may be comprised in a membrane distillation apparatus, or may be utilized as a filter of a humidifier or a water purifier.

5 Claims, 3 Drawing Sheets

